

CUORE (Cryogenic Underground Observatory for Rare Events)

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CUORE (The Cryogenic Underground Observatory for Rare Events) is designed to be a large (750kg) array of 1000 TeO_2 crystals to search for rare events, particularly for the neutrinoless double beta decay of ^{130}Te . This experiment will succeed the recently completed MiBeta experiment and the presently-running Cuoricino experiment (62 crystals).

Work in three major areas proceeded for this experiment: 1) construction of the Cuoricino experiment, 2) continued studies of the NTD germanium thermistor material, and 3) preparations for the CUORE proposal.

Two of us (Norman and McDonald) spent a total of 9 weeks at the Laboratorio Nazionale del Gran Sasso working on the construction of the Cuoricino tower. Our work involved the instrumentation of the crystals and the wiring of the tower.

Other members of the American part of the collaboration, including students from the Universities of South Carolina and Notre Dame, worked on the construction of Cuoricino. There are several important improvements in Cuoricino compared to the completed Mi-Beta. 1) 44 of the crystals (eleven planes of 4 crystals each) are 5-cm cubes and are prototypes for CUORE. These crystals were polished with "clean" materials, i.e., measured to be free of natural radioactivity, and were left with a "frosted" surface compared to the optical surface on the earliest prototypes from the Institute of Ceramics in Shanghai. 2) an additional 18 crystals (two planes of 9 each) are the old Mi-Beta crystals, including some enriched in either ^{128}Te or ^{130}Te . The hope with these is to be able to observe and measure the half-life of the two-neutrino double beta decay of ^{130}Te . 3) the copper support structure was given special surface treatment to reduce

radioactivity, and 4) the assembly of the tower was accomplished in a nitrogen atmosphere in a specially-constructed glove box.

The thousands of nearly identical thermistors needed for CUORE will be produced by the neutron transmutation doping (NTD) of natural germanium. This involves subjecting Ge to about $3 \times 10^{18} / \text{cm}^2$ neutrons to produce doping levels of about 1×10^{17} Ga atoms per cm^3 , 3×10^{16} As atoms per cm^3 and 2×10^{15} Se atoms per cm^3 . This year we made significant progress toward understanding the absolute magnitude of the dopant concentrations by using neutron activation analysis and secondary ion mass spectroscopy to measure the dopant levels. This was successful for the first try, but additional work will be needed to refine these procedures. The importance of this work is to be able to measure the properties of newly-fabricated thermistors without cooling them and measuring their resistance. We plan to measure the dopants and then control the fabrication of all thermistors to 1% (or better) precision compared to a set of thermistors with the proper measured properties at low temperature.

We have been in constant contact with the group in Milan in terms of the division of responsibilities for CUORE and preparations for a proposal. The plan is to share costs equally between the American collaborators (mainly LBNL and the University of South Carolina) and the European groups. The proposal will be written this year.

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